Despite continued improvements in air quality, the air quality issues facing States and regions require that policymakers consider strategies to reduce emissions from all sources—point and area sources, on-road vehicles, and non-road engines. The array of strategies available to transportation and air quality officials range from regulatory to voluntary and from technology- and fuel-baed strategies to market-based measures aimed at changing driver behavior.

Conformity

Transportation conformity is a process to ensure that Federal funding and approval are given to those transportation activities that are consistent with air quality goals. The conformity regulation requires that all transportation plans and programs in non-attainment or maintenance areas conform to the State's air quality plan, known as the State Implementation Plan or SIP. It ensures that transportation activities do not worsen air quality or interfere with the purpose of the SIP, which is to attain the NAAQS. Meeting the NAAQS often requires emission reductions from mobile sources. Several types of highway emissions reduction strategies are available (and, in some regions, required) to help regions attain the standards.

The conformity rules are being developed for new "transitional" ozone areas—those that attain the one-hour standard by 2000 but not the new eight-hour standard.

Inspection and Maintenance (I&M) Programs

An I&M program identifies and corrects excessive vehicle emissions.

- Basic I&M includes annual or biennial inspections by the State or municipal authority at central or local inspection facilities. Basic I&M is required in certain ozone and CO non-attainment areas.

- Enhanced I&M includes an inspection for tampering with emissions controls or misfueling, use of computerized emission analyzers, and inspection of on-board diagnostic systems. States supervise testing annually or biannually at testing stations.

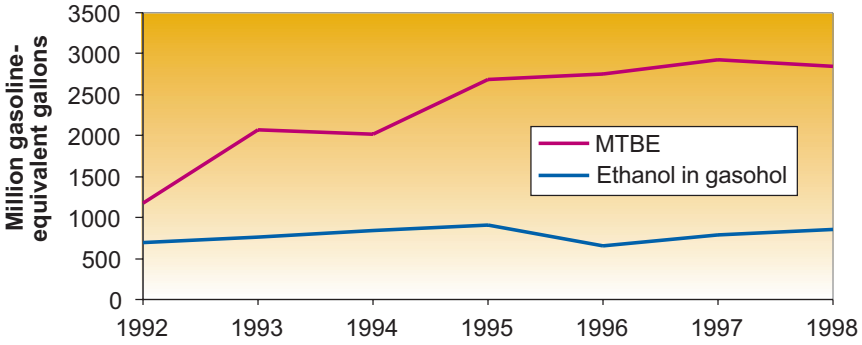
Policy Responses

Technology Improvements

Emissions reductions can be achieved by improving engine technology or using alternative fuels or reformulated gasoline. Among engine improvements, the catalytic converter, which extracts pollutants from exhaust, has made the largest contribution to reducing vehicle emissions in recent years. A catalytic converter does not operate effectively, however, until it reaches its operating temperature (after a car has been running for a few minutes). During the first few minutes of running time, the car emits a higher amount of pollutants (cold-start emissions). To reduce these emissions, researchers are exploring ways to reduce the time needed to heat the catalytic converter.

Partnership for a New Generation of Vehicles (PNGV)
The Partnership for a New Generation of Vehicles (PNGV), established in 1993, is the cornerstone of U.S. research and development for light-duty vehicles. A joint venture of the U.S. government and the U.S. Council for Automotive Research (a research consortium formed by General Motors, Ford, and Chrysler), the PNGV has a goal to develop technologies that will assist the development of vehicles with up to three times the fuel efficiency of today's mid-size family sedan (implying fuel economy of about 80 mpg), at an equivalent life-cycle cost (vehicle purchase plus operating costs) that meets customer needs for quality, performance, and utility. By developing the technologies for more fuel efficient vehicles, the PNGV is expected to support efforts to reduce greenhouse gas emissions from transportation.

Use of Reformulated Vehicle Fuels



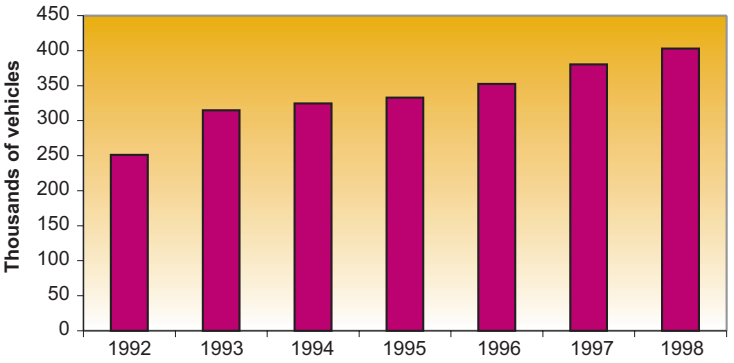
Reformulated fuel is chemically altered, cleaner-burning petroleum fuel. Reformulated fuel may have a lower Reid vapor pressure due to the reduction or removal of butane, benzene, aromatics and olefin compounds (smog precursors). It may lower levels of reactive and evaporative HC emissions and significantly reduce benzene and sulfur emissions, CO, and NO_x emissions.

Oxygenated fuel is a form of reformulated fuel. Oxygenates such as methyl tertiary butyl ether (MTBE) or ethyl tertiary butyl ether (ETBE) are blended with gasoline to increase the oxygen content for more complete combustion in engines, resulting in lower CO emissions.

Blending of oxygenates increased greatly after the Clean Air Act Amendments of 1990 established requirements for the use of oxygenated and reformulated gasoline in a number of large metropolitan areas. Oxygenates comprise about 3% of gasoline consumed. MTBE is the largest oxygenate in use, followed by ethanol and a very small amount of other alcohols and ethers.

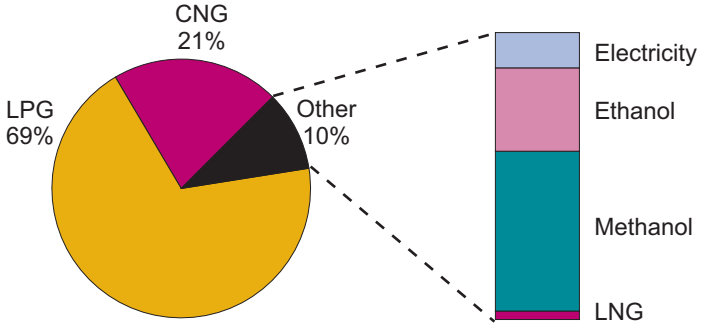
Source: U.S. DOE, Energy Information Administration. *Alternatives to Traditional Transportation Fuels*. December 1997. Table 10, p. 20.

Alternative Fueled Vehicles in Use



Use of alternative fuels for motor vehicles has increased rapidly in recent years. More than 402,000 alternative fueled vehicles (AFVs) were on the road in 1998, a 60% increase since 1992. These increases are due to a number of policies including the availability of federal funding under the CMAQ program and the Energy Policy Act of 1992 (EPACT) and Presidential Executive Order 12844, which require minimum AFV purchases for federal government vehicle fleets. Mandates requiring state and fuel provider fleets to acquire AFVs also took effect in model year 1997.

Share of Alternative Fueled Vehicles by Fuel Type, 1998



Most alternative fueled vehicles in use in 1998 were designed to operate on liquefied petroleum gas (LPG). The second most popular alternative fuel was CNG.

Source: U.S. DOE, Energy Information Administration. *Alternatives to Traditional Transportation Fuels*. December 1997. Table 1, p. 9.

Alternative Fuels

A variety of alternative fuels are available and can be used to combat different air pollution problems:

Liquefied petroleum gas (LPG) - A fossil-fuel derivative composed of 95% propane and 5% butanes. It produces lower CO emissions, but NO_x emissions may be higher.

Natural gas - A fuel that can be in compressed (CNG) or liquified (LNG) form. The CNG form, more common in the transportation sector, is stored in high-pressure cylinders. CNG generates lower CO and VOC emissions than conventional gasoline.

Methanol - Wood alcohol made from natural gas, coal, or biomass.

Ethanol - Grain alcohol made from corn, sugarcane, or woody biomass. Ethanol blends may reduce CO emissions, but their effect on ozone is negligible.

Electricity - Electric vehicles may be powered by batteries charged at home or at charging stations with electricity from power plants. They have no tailpipe emissions; overall emissions depend on power plant energy sources.

Hydrogen - A clean-burning fuel that can be produced from coal, natural gas, oil, solar, or wind energy. A vehicle operating on a fuel cell, which generates electricity by harnessing the reaction of hydrogen and oxygen to make water, produces no CO or VOC emissions and extremely low NO_x emissions.

Vehicle / engine design is a critical factor affecting emissions from alternative fueled vehicles.

Hybrid vehicles can operate on two power sources. A hybrid electric vehicle uses a high-energy-density battery and small internal combustion engine. The in-use emissions of the hybrid electric vehicle depend on the fuel used in the internal combustion engine – most typically diesel, gasoline, or CNG.

Policy Responses

Transportation Control Measures

States and localities can help reduce motor vehicle emissions by implementing measures to manage travel demand or improve traffic flow. "Transportation control measure" (TCM) is the term used to refer to these efforts when they are included within a State Implementation Plan. Examples of these measures include:

Alternatives to Single Occupant Vehicle Travel

Measures that focus on providing alternatives to single-occupant vehicle travel, such as options for carpooling, transit, and bicycling:

Bicycle/pedestrian facilities - Provision of paths, special lanes, lockers, showers, or other facilities

Area-wide ridesharing - A program that provides carpool matching and information services

HOV lanes - Highway lanes reserved for high-occupancy vehicles (HOVs), i.e., buses, vanpools, and carpools

Park & ride facilities - Parking lots or facilities located to provide access to a transit station, HOV lane, bus service, or to encourage carpooling

Transit improvements - Transit service expansion or improvements.

Traffic Flow Measures

Measures that focus on improving the smoothness of traffic flow to reduce stop-and-go traffic conditions:

Signal timing improvements - Intersection signal light changes to enhance the flow of vehicles on arterial streets.

Incident management - Quick removal of traffic blockages caused by accidents and breakdowns.

Market Measures

Measures that rely on pricing as an incentive to reduce travel congestion.

Parking pricing - Increases in parking fees or reduced fees for carpools

Parking cash-out/transit subsidies - A program in which employees are given the option of taking the cash value of a parking space or a transit subsidy instead of free parking at work.

Buy-backs of old cars - Programs that pay owners of older cars to scrap their vehicles

Congestion/value pricing - Assessment of road charges during hours of peak demand

Emissions/VMT taxes - Use of vehicle registration fees charged on the basis of emissions rates and / or miles driven

Fuel taxes - Taxes paid at the pump on motor vehicle fuels

Employer-based Measures

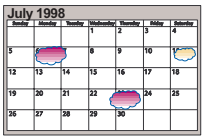
Measures that involve implementation by employers.

Compressed workweeks - Extension of the typical workday in order to reduce the number of days worked, thereby reducing the number of work trips

Telecommuting - Arrangements allowing employees to work at home or at satellite offices close to home

Employer trip reduction - A State or local government-regulated program requiring employers, usually above a certain size to implement plans that encourage employees to reduce vehicle travel to work

Other Innovative Measures



Episodic measures - Measures that are put in place during days when air quality is expected to be poor to reduce exceedances of air quality standards

Land use planning - Incentives and planning to encourage development patterns that place jobs, housing, and services closer together and that encourage pedestrian- and transit-friendly environments

Parking restrictions - Parking policies that discourage vehicle use such as time restrictions and eliminating on-street parking

Funding

Numerous funding mechanisms are available to implement these strategies. Traditional transportation funding sources, State and local sources, user fees, and private sector involvement may be used. The Congestion Mitigation and Air Quality Improvement (CMAQ) Program was developed under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and reauthorized under the Transportation Equity Act for the 21st Century (TEA-21). The CMAQ Program is a potential funding source for measures to reduce air pollutant emissions from motor vehicles.

CMAQ Program

The CMAQ Program allocates funds to States to implement of TCMs and other strategies to help areas meet the NAAQS for ozone, CO, and PM. State and local governments select the types of projects to fund and coordinate them through metropolitan planning organizations (MPOs). The projects vary by region but typically include the following types of measures:

- Transit improvements
- Shared-ride services
- Traffic flow improvements
- Demand management strategies
- Pedestrian and bicycle programs
- Inspection and maintenance (I&M) programs

Other projects, such as alternative fuels and education and outreach programs, may also be eligible for CMAQ funds. In addition, TEA-21 includes certain newly eligible categories of projects, such as extreme low-temperature cold start programs, magnetic levitation transportation technology deployment programs, and public-private partnerships.

Web Sites

U.S. Department of Transportation (DOT)
http://www.dot.gov

U.S. DOT, Federal Highway Administration (FHWA), Office of Environment and Planning
http://www.fhwa.dot.gov/environment/

U.S. DOT, Federal Highway Administration, Office of Highway Information Management
http://www.fhwa.dot.gov/ohim

U.S. DOT, Bureau of Transportation Statistics (BTS)
http://www.bts.gov/

U.S. Environmental Protection Agency (EPA)
http://www.epa.gov

U.S. EPA, Office of Air and Radiation
http://www.epa.gov/oar/oarhome.html

U.S. EPA, Office of Air Quality Planning and Standards
http://www.epa.gov/oar/oaqps

U.S. EPA, Office of Mobile Sources
http://www.epa.gov/oms

U.S. EPA, Transportation Air Quality (TRAQ) Center
http://www.epa.gov/oms/traq

U.S. EPA, Global Warming Site
http://www.epa.gov/globalwarming

Resources

Other Government Agencies

California Air Resources Board
http://www.arb.ca.gov

Oak Ridge National Laboratory, Center for Transportation Analysis
http://www-cta.ornl.gov

U.S. Census Bureau
http://www.census.gov

U.S. Department of Energy (DOE), Energy Information Administration (EIA)
http://www.eia.doe.gov

Organizations, Programs and Academic Sites

Center for Transportation and the Environment, North Carolina State University
http://itre.ncsu.edu/itre/cte

Ozone Transport Commission (OTC)
http://www.sso.org/otc/otc.htm

Partnership for a New Generation of Vehicles
http://www.ta.doc.gov/pngv

State and Territorial Air Pollution Program Administrators / Association of Local Air Pollution Control Officials (STAPPA / ALAPCO)
http://www.4cleanair.org

Texas Transportation Institute
http://tti.tamu.edu

Transportation Research Board (TRB)
http://www.nas.edu/trb

Statistical Publications (Annual Editions)

Alternatives to Traditional Transportation Fuels, U.S. DOE, EIA.

Emissions of Greenhouse Gases in the United States. U.S. DOE, EIA.

Highway Statistics. U.S. DOT, FHWA.

National Air Quality and Emission Trends Report. U.S. EPA.

National Air Pollutant Trends. U.S. EPA.

National Transportation Statistics. U.S. DOT, BTS.

Our Nation's Highways: Selected Facts and Figures. U.S. DOT, FHWA.

Statistical Abstract of the United States. U.S. Department of Commerce, Bureau of the Census.

Transportation Energy Data Book. U.S. DOE, Oak Ridge National Laboratory.

Transportation Statistics Annual Report. U.S. DOT, BTS.

Other Publications

Congestion Mitigation and Air Quality Improvement (CMAQ) Program Annual Report. U.S. DOT, FHWA. Annual editions.

Congestion Mitigation and Air Quality Improvement Program: Indirect Benefits. U.S. DOT, FHWA. Prepared by Louis Berger & Associates, 1997.

Congestion Mitigation and Air Quality Improvement Program Review. U.S. DOT, FHWA. Prepared by Hagler Bailly (Apogee Research) (DOT-T-97-14), 1997.

Cost Effectiveness of Transportation Control Measures by CMAQ Category. Center for Transportation and the Environment (CTE), North Carolina State University, 1997.

Costs and Effectiveness of Transportation Control Measures (TCMs): A Review and Analysis of the Literature. National Association of Regional Councils. Prepared by Hagler Bailly (Apogee Research), 1994.

Resources

Emissions Standards Reference Guide for Heavy-Duty and Nonroad Engines, U.S. EPA, Office of Mobile Sources, (EPA420-F-97-014), September 1997.

Greenbook: Nonattainment Areas for Criteria Pollutants. U.S. EPA. http://www.epa.gov/oar/oaqps/greenbk/

Interagency Consultation: The Key Toward Collaborative State and Local Decision-making in the Conformity Process. U.S. DOT, FHWA (DOT-T-97-11), 1996.

The MOBILE Model and Transportation Planning: A Brief Overview. U.S. DOT, FHWA, Prepared by Volpe National Transportation Systems Center (DOT-VNTSC-FHWA-95-7), 1996.

Policies and Measures for Reducing Energy Related Greenhouse Gas Emissions: Lessons from Recent Literature. U.S. DOE, Office of Policy and International Affairs, July 1996.

States Guidance Document: Policy Planning To Reduce Greenhouse Gas Emissions, Second Edition. U.S. EPA, Office of Policy, Planning, and Evaluation (EPA Pub. #230-B-98-002), 1998.
http://www.epa.gov/globalwarming/actions/state/state/toc.html

Toward a Sustainable Future: Addressing the Long-Term Effects of Motor Vehicle Transportation on Climate and Ecology. Transportation Research Board, Special Report #251, 1997.

Transportation and Global Climate Change: A Review and Analysis of the Literature. U.S. DOT, FHWA. Prepared by Hagler Bailly (Apogee Research), July 1998. http://www.fhwa.dot.gov/environment/lit.htm

Transportation Pricing for California: An Assessment of Air Quality, Congestion, Energy, and Equity Impacts. California Air Resources Board. Prepared by Deakin, Harvey, & Skabardonis (DHS, Inc.), 1996.

Transportation Conformity: A Basic Guide for State and Local Officials. U.S. DOT, FHWA and FTA. (FHWA-PD-97-035, HEP-40), 1997.
http://www.fhwa.dot.gov/environment/fhwaconf.pdf

VMT Growth and Improved Air Quality: How Long Can Progress Continue? U.S. DOT, FHWA. Prepared by Volpe National Transportation Systems Center (DOT-VNTSC-FHWA-97-6), 1997.
http://www.fhwa.dot.gov/environment/vmt_grwt.htm

Purpose

This brochure provides an overview of facts and figures regarding the linkages between transportation and air quality. This brochure focuses primarily on transportation-related emission trends, policies, technologies, and standards that affect on-road mobile sources including automobiles, light-duty trucks, and heavy-duty trucks.

Terms

CAAA	The Clean Air Act Amendments of 1990
CO	Carbon monoxide – a criteria pollutant – a product of incomplete fuel combustion
Fugitive dust	Largely windblown dust from paved and unpaved roads
HC	Hydrocarbons – gaseous compounds made of carbon and hydrogen (used interchangeably with VOC)
NAAQS	The National Ambient Air Quality Standards – Federally established standards for pollutant concentrations that States, cities, and towns must meet by specified deadlines
NO_x	Oxides of nitrogen – a collective term for all compounds of nitrogen and oxygen (includes nitrogen monoxide, nitrogen dioxide, etc.)
Nonattainment areas	Areas that have failed to meet the NAAQS
Non-road engines	Aircraft, trains, boats, off-road recreational vehicles, farm and construction equipment, and yard tools
On-road vehicles	Cars, vans, buses, light-duy and heavy-duty trucks, and motorcycles
Ozone	A criteria pollutant – an oxygen compound that can develop when NO_x, VOC, and sunlight interact in the lower atmosphere; the primary consitutent of smog
PM_{10}	Particulate matter with a diameter less than 10 micrometers
$PM_{2.5}$	Particulate matter with a diameter less than 2.5 micrometers
Point & area sources	Stationary sources of emissions, including electric utilities, factories, petroleum refineries, dry cleaners, and so forth
Precursors	Pollutants that contribute to the formation of other pollutants; HC and NO_x are precursors of ozone
PSI	Pollution Standards Index; a composite measure of pollutant concentrations; a PSI value of 100 or more means that air quality is unhealthful.
VMT	Vehicle miles traveled
VOC	Volatile organic compounds – gaseous compunds made of carbon and hydrogen (used interchangeably with HC)